FPV Drone Flight Controller Firmware Overview

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This is an introduction to the different flight controller firmware options available for FPV drones quadc
We will talk about the history and background of these FC firmware, and the application and what they
intended to do.

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If you are flying FPV, you probably have already settled in on one of these flight controller firmware. Th no such thing as “the Best FC firmware” as they all have their pros and cons, and it depends on the application.

Some of these FC firmware are designed primarily for raw flight performance for racing and freestyle fl while others are capable of autonomous GPS flights.

For someone who has just started it could be overwhelming which to pick, and I hope this article can h decide. New to FPV? Check out this buyer’s guide on flight controllers for FPV drones.

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Freestyle Flying and Racing

Betaflight

Betaflight is the most widely used flight control software for mini quad out there today, and for good rea

It was forked from Cleanflight to focus on the leading edge of new features and flight performance ava for racing drones, hence the name **Beta**-flight.

It supports a very wide range of FC targets. A default tune flies very well. It is packed with features for racers, acro/freestyle pilots and beginners alike. It remains open-source, has a great following of contr and regular updates.

Betaflight is my own personal favorite and I very confidently recommend you give it a try if you haven't already.

However although with all the options in Betaflight make it one of the most flexible and powerful flight software, it can also be one of the most awkwardly complex to setup, learn and use.

Betaflight is my go-to firmware at the moment for freestyle and racing FPV drones, and it also has bas capability, such as Rescue mode (basic return to home).

I have written many tutorials for Betaflight:

- Project Home Page on GitHub

KISS

Keep It Super Simple, is the concept used here.

KISS was developed by Flyduino, which has been making multirotor components since 2011. It is a proprietary firmware (closed source) and somewhat dependant on hardware interfacing (a lot like Appl products).

The KISS GUI is more simple than the Betaflight Configurator with far fewer settings and options, leavi of the quicker setup/configuration processes to get airborne. But the lack of options in its GUI can som be more difficult to adjust problematic configurations. With that said KISS is one of best FC firmware o for racing and acrobatic flying with unique characteristics. Many top pilots fly KISS and recommend KI builds.

You don't have any choice when it comes to flight controllers, there is no 3rd party company making K compatible hardware.

There isn't as a large user base as Betaflight, so it might be slightly harder to get help when you have issue. And the lack of tools in the software to troubleshooting can be frustrating at times.

Product Page: https://oscarliang.com/product-rk3p

FlightOne FalcoX

It was originally named Raceflight, and it was forked from Betaflight/Cleanflight. But later the code was completely rewritten according to the developers, became closed source and it was renamed to Flight

The latest variant of FlightOne is called FalcoX. It's super easy to use as you can set it up completely f OSD menu. You don't need a computer at all unlike Betaflight. Arguably it's even easier than KISS to s extent in my opinion.

FalcoX focuses on pure racing and acro flying as well as being oriented around F4 flight controllers. It' known for its direct stick feel and smoothness.

But due to the lack of options in the configurator, some top pilots still prefer Betaflight as they l e t have more freedom to tune the quads the way they want. Just like KISS, it's slightly harder to get help

Product Page: https://oscarliang.com/product-iyx4

Emuflight

A branch of Betaflight, without going into too much detail, Emuflight is a result of some disagreement b the devs regarding filtering. According to their users, Emuflight has a unique stick feel compared to oth firmware.

Since it's a fork of Betaflight, it runs on all Betaflight hardware. Sometimes people give Emuflight a try they can't get Betaflight to perform the way they want. If you don't like it you can always go back to Be

Autonomous Flying

iNav

As the name implies, iNav is geared more towards navigation and autonomous features such as flying waypoint missions and Return to Home (RTH) functions.

It forks from Cleanflight just like Betaflight, hence they share many similar features, even the configura interface look familiar, so it's easy for Betaflight users to learn. However, apart from multirotors, iNav a supports fixed-wing aircraft and RC cars.

iNav has full GPS capability and mission planning is there (waypoints), it is being developed and impro consistently. However it lags behind the latest flight performance features compared to Betaflight wher comes to freestyle and racing drones.

iNav supports some but not all Betaflight flight controllers.

If you are interested in more of that UAV/Drone style of flight, this is definitely an option to explore.

- iNav GitHub

Ardupilot

Ardupilot is probably the most popular open-source firmware for GPS autopilot. It's been in act

The firmware supports almost every type of aircraft you can think of: multirotors, fixed wings, cars, boa submarines…

When it comes to GPS and autonomous flying, this is the ultimate choice without doubt, as it's the mos system, and being very advanced in Mission Planning and monitoring system.

However it's not a popular choice for multirotor racing and freestyle flying, because it lacks a lot of mod features and supports of the latest protocols (SmartAudio, DShot, Crossfire etc).

Honorable Mentions

These firmware are less popular but worth knowing.

Multiwii

Multiwii is regarded as the beginning of quadcopter firmware, the inspiration for many popular multirot firmware later on. The firmware was created using the IMU sensor from the Nintendo Wii Nunchuck, combined with an Arduino board, thus the name Multiwii (Multirotor, Wiimote).

Baseflight

Baseflight was one of the very first widely used 32-bit FC firmware based off of the 8-bit Multiwii flight controller firmware. Today, Baseflight is not being updated and is widely considered to be an outdated/ firmware. Despite all the controversy surrounding the software author, TimeCop, Baseflight did help br to some of the greatest software we use today, and is worth noting in my opinion.

- Baseflight GitHub

Cleanflight

Forked (branching out) from Baseflight, came Cleanflight aiming to be a "clean code" version of Basefl easier maintainability and future development.

It quickly became a widely used and dependable flight control software. Since its beginning, Cleanfligh been forked into Betaflight and iNav. Many new features were added and tested from those, ar erg

However the development and update has slowed down considerably, we think going forward Betaflig better alternative.

- Cleanflight GitHub

Butterflight

Butterflight is a fork of Betaflight that aims to bring a renewed focus on mini quad flight performance ar cutting edge features.

Right now (Apr 2018), the main differences between Butterflight and Betaflight are the software filterin gyro and AKK VTX Smart Audio support.

Update (2019): development seems to have stopped this year.

OpenPilot

One of the earliest open source FC firmware development for multirotors which influenced some majo progressions in flight control firmware options. OpenPilot was discontinued and replaced by LibrePilot but it is another firmware worth noting for what has become of its code.

LibrePilot

LibrePilot, forked from OpenPilot, focuses on research and development for use in many, many differe applications, even robotics .

While not as popular in the mini quad community, nor having support for as many hardware targets as firmware in this list, it does show recent updates has a reliable team of developers and remains open s

- LibrePilot website

TauLabs

TauLabs, another fork of OpenPilot focusing on autopilot UAV oriented research and development. Tar professionals, researchers and and students alike, the project not only reaches out to major researche offers an entry level platform with fast and easy setup/configuration for any group who has use JAV

agricultural, air quality or whatever your brain can think up.

- TauLabs GitHub

dRonin

Last, but certainly not the least in this list is dRonin which is sort of the grandchild of OpenPilot.

Its name says it all, dRonin has a core focus on FPV drone racing. With regular updates, open source, development team seeking to improve racing and acrobatic flying performance, I see great potential h

They have developed an auto-tune mode that can custom tune PID's specific to your mini-quad build, as having the very quick and easy setup/configuration wizard.

Its main downfall would be the somewhat limited supported FC targets, but it is a sophisticated list of fl controllers with great reviews.

- dRonin GitHub

Conclusion

If you are new to the hobby, I'd strongly recommend starting with Betaflight flight controller firmware, a have a whole range of hardware options. There are a ton of tutorials and resources online as it has a h user base. If you prefer to do autonomous flying, then iNav might be the better option.

You can find out about what Firmware Mini Quad flight controller use in this spreadsheet:

I compiled the specifications of all FC's for mini quad in this spreadshe you can compare them more closely.

Edit History

- May 2017 – article created

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website. Note that all comments are held for moderation before appearing.

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7 COMMENTS

KRISHNA

29th August 2019 - 8:32 am

what about PX4..

DANIEL

Hello, thank you for your website. Do you have an index for your drone related pages? Also not into racing I want to build a drone to see what is happening on my 135 acres. Which firm would be best for me? From what I am reading iNav or LibrePilot seems appropriate, are th P.S. I am new to this field.

SAMUELE.RINI

11th June 2018 - 2:19 pm

Thank you very much for the comprehensive write-up about FC's firmwares. Very helpful.

JASON

30th October 2017 - 5:37 pm

I had a USRobotics Solo that runs Ardupilot. How does that fit into the mix of firmwares?

PHIL HORD

27th May 2017 - 3:29 am

Haha. "dRonin. Its name says it all." What the hell does that even mean?

OSCAR

28th May 2017 - 4:50 pm

it sounds like "Droning" ;D

TILO

8th August 2017 - 3:00 am

Ty Oscar. All of the info, and specifically that name explanation. So simple didn't see it.

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